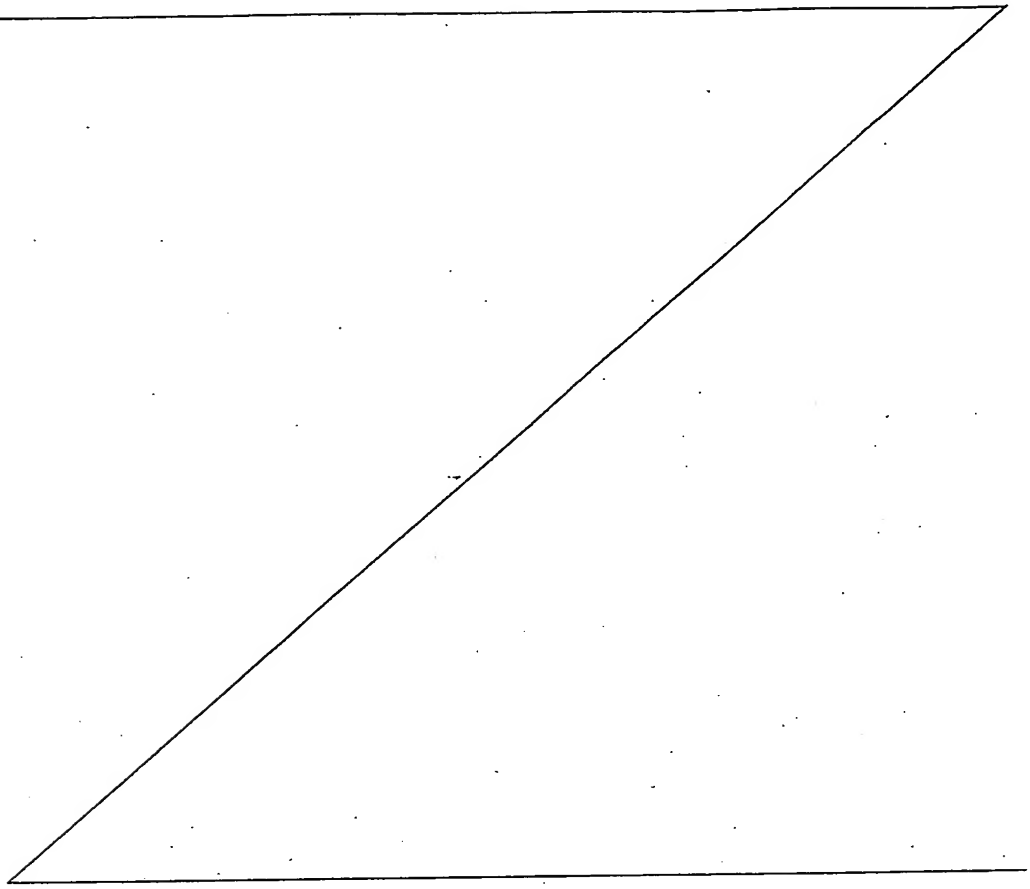
Amended Pages 4-7 and 21-22



resulting from the casting on the one hand (versus the disappearance of these defects) and, on the other hand, the configuration of the convective movements of the liquid metal in the mold. Thus, the origin of the observed quality defects turns out to be due not only to flows of the unstable type, which one might have suspected, but also the stable configuration in "single loop" mode.

The object of the present invention is therefore to offer the continuous slab casting operator a simple and effective tool, attached to his machine without having to reconsider its design, in order to allow him to assuredly establish a "double loop" mode without in any way modifying the adjustment of the casting parameters.

With this objective in mind, the subject of the invention is a method for controlling the configuration

of the movements of the liquid metal poured into a continuous casting mold for metal slabs or other similar flat products, especially made of steel, by means of a submerged nozzle provided with lateral outlet ports turned so as to face the short walls of the mold, it being possible for said configuration to be in "single loop" or "double loop" mode, or "unstable", characterized in that magnetic fields are employed, at the ports of the submerged nozzle, that travel horizontally outward, in the direction going from the nozzle toward each short mold wall, by means of polyphase linear electromagnetic inductors placed so as to face at least one long wall of the mold on either side of the nozzle and the magnetic fields are made to travel throughout the entire casting operation, so as to set up a steady configuration stabilized in "double loop" mode.

According to another method of implementation, the traveling magnetic fields are employed only if the configuration of the movements is not naturally already in "double loop" mode.

The subject of the invention is also an installation for carrying out the method according to said preferred method of implementation, comprising at least one pair of linear traveling-magnetic-field electromagnetic inductors mounted so as to face at least one long wall of the mold and oriented so as to produce a horizontal traveling magnetic field, and a controlled polyphase power supply connected permanently to said inductors in order to produce in each of them a traveling magnetic field directed solely outward, in a direction going from the nozzle toward a short wall of the mold, said magnetic fields acting on the streams of liquid metal arriving in the mold via the ports of the submerged nozzle.

As will have doubtless been understood already, the invention makes use of a means that is well known and, if one may say so, that has been commercially available for a long space - the moving magnetic field produced by a polyphase static linear inductor - in order to act dynamically on the liquid metal within the mold so as to establish a "double loop" mode, or to stabilize it if it is already naturally present.

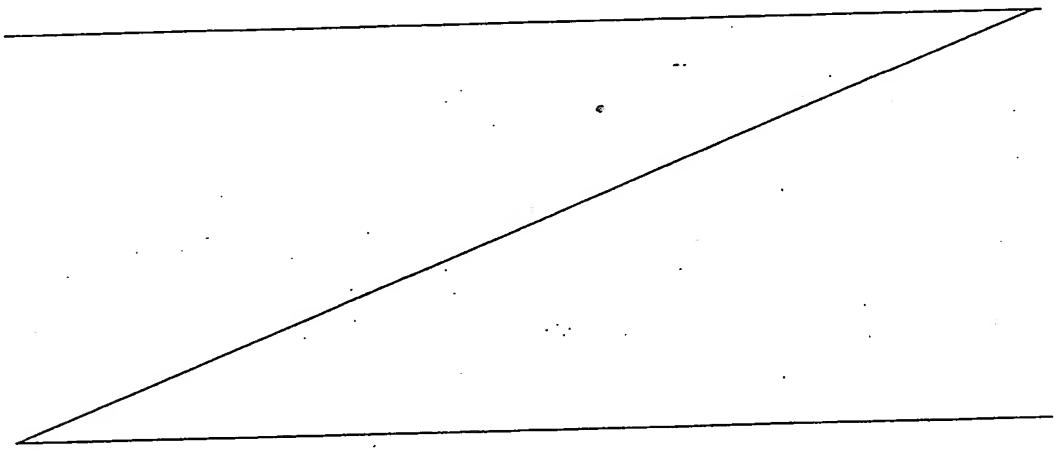
The first applications of magnetohydrodynamics (MHD) to the continuous casting of metals now go back almost thirty years and their success has been unfailing up to now. On the contrary, continuous advances mark its history. The first descriptions related to the stages in the casting machine beneath the mold, particularly the secondary cooling zone because of the absence of a magnetic screen effect that the copper walls of the mold would otherwise oppose. However, thyristor-based polyphase electrical current supplies quickly appeared that allowed them to work at low excitation current frequencies, of below 10 Hz, so that, taking into account the available power levels, the residual screen effect that the copper walls would still oppose no longer represented an obstacle to the application of MHD within the actual mold, said magnetic fields acting on the streams of liquid metal arriving in the mold via the ports of the submerged nozzle.

Many and varied in-mold applications have thus been entrusted to MHD, ranging from simple movement of the metal, rotating about the casting axis for example, to its acceleration or braking in the direction of movements that the metal already has naturally, or to imposed changes of direction. Very many published documents (studies, articles, patents) have been dedicated to it. We simply mention here, for simple historical reference, French patent No. 2 187 465

(IRSID) dating from 1972 and already describing a steering action rising along the walls caused by a vertically traveling magnetic field acting on the metal. The aim was thus to favor an equiaxed-type solidification structure right from the mold, and to improve the sub-shell cleanliness via washing of the solidification front by the ascending currents of liquid metal carrying with them the gas bubbles formed *in situ* and the nonmetallic inclusions up to the meniscus where they are attached to the supernatant cover slag.

We also mention, closer to the present time, and because the application in question is quite close to that of the invention, if not complementary thereto, European Patent Application published under No. 0 550 785 (NKK Corp.). That document in fact proposes the use of inwardly traveling magnetic fields, that is to say traveling from the short mold walls toward the nozzle, in order to brake the jets of liquid metal leaving the ports so as to moderate the vigor of the double-loop movements when the measured velocities at the meniscus are estimated to be too high.

Likewise, European Patent Application published under No. 0 151 648 (KSC) describes the possible choices between vertical stirring of the metal in the mold by



CLAIMS

1. A method for controlling the configuration of the movements of the liquid metal poured into a continuous casting mold for metal slabs or other similar flat products, especially made of steel, by means of a submerged nozzle provided with lateral outlet ports turned so as to face the short walls of the mold, it being possible for said configuration to be naturally in "single loop" or "double loop" mode, or else to be "unstable", characterized in that magnetic fields are employed, at the ports (2) of the submerged nozzle (3), that travel horizontally outward, in the direction going from the nozzle (3) toward each short mold wall (5), by means of inductors (14, 14', 15, 15') placed so as to face at least one long wall of the mold on either side of the nozzle, and in that the magnetic fields are made to travel throughout the entire casting operation, so as to set up a steady-state configuration stabilized in "double loop" mode.

2. The method as claimed in claim 1, characterized in that said traveling magnetic fields are employed only if the configuration of the movements of the metal poured into the mold is not naturally in "double loop" mode.

3. An installation for implementing the method as claimed in claim 1, comprising an electromagnetic unit (10) formed by at least one pair of linear traveling-magnetic-field inductors mounted so as to face at least one long wall of the mold and oriented so as to produce a horizontal traveling magnetic field, and a controlled polyphase power supply (11), characterized in that said power supply is permanently connected to each pair of

linear inductors (14, 14', 15, 15') of said electromagnetic unit (10) in order to produce in each of them a traveling magnetic field directed solely outward, in a direction going from the submerged nozzle (3) toward a short wall of the mold (5), said magnetic fields acting on the streams of liquid metal arriving in the mold (18) via the ports (2) of the submerged nozzle.